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CARNIVOROUS PLANT NEWSLETTER

Journal of the International Carnivorous Plant Society

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CARNIVOROUS PLANT NEWSLETTER

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Front Cover: *Drosera binata* and *Cephalotus follicularis* in Western Australia. See article on page 68. Photograph by Robert Gibson.

Back cover: Veinless *Sarracenia purpurea* in Grey County, Ontario, Canada. Unless carefully inspected, this plant could be mistaken for *Sarracenia purpurea* f. *heterophylla*. See article on page 79. Photograph by Carl Mazur.

Carnivorous Plant Newsletter is dedicated to spreading knowledge and news related to carnivorous plants. Reader contributions are essential for this mission to be successful. Do not hesitate to contact the editors with information about your plants, conservation projects, field trips, or noteworthy events. Contributors should review the "Instructions to Authors" printed in the March issue of each year. Advertisers should contact the editors.Views expressed in this publication are those of the authors, not the editorial staff.

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D. anglica—Oregon, USA
D. auriculata
D. binata
D. binata—Coromandel, NZ
D. burmannii
D. capensis 'Albino'—white flower
D. capensis—narrow leaf
D. capensis—red
D. dielsiana
D. filiformis var. *filiformis*
D. glanduligera
D. intermedia—Cuba
D. intermedia—Florida, USA
D. intermedia—Germany
D. intermedia—New Jersey, USA
D. intermedia—North Carolina, USA
D. intermedia—Rhode Island, USA
D. intermedia—Venezuela
D. madagascariensis
D. peltata
D. rotundifolia—Alaska, USA
D. rotundifolia—New Hampshire, USA
D. stenopetala
Pinguicula lusitanica
Proboscidea louisianica (noncarnivorous)
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S. rubra subsp. alabamensis—ESA/CITES, USA sales only
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John Brittnacher, Manager • john@carnivorousplants.org

Observations of *Cephalotus follicularis* and *Drosera binata* in Western Australia

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Keywords: observations: *Cephalotus follicularis*, *Drosera binata*, *Utricularia paulineae*, Western Australia.

During late October, 2003 I had the pleasure of travelling to Walpole in the south of my state of Western Australia, with another carnivorous plant enthusiast Darren O'Brien, and my two wonderful Italian visitors, Christiano (Chris) Perrucci and Gabri Motta. Our aim was to make some observations of a relatively newly discovered location of *Drosera binata* (Grieve, 1998), until recently thought only to be native to the east coast areas of Australia and New Zealand. I had successfully found the plants only once before—less than a month earlier when I visited the site with Robert Gibson (see Figure 1). All of my other previous trips to find this location had proven fruitless, because it was so hidden by thick grasses and tall swamp bushes. On those previous trips I only found a few *D. hamiltonii* plants and several large tiger snakes, which thrive in this environment.

During the previous summer a huge bush fire had burnt the whole area clean, exposing the entire swamp. When Chris, Gabri, and I arrived, we discovered that the site had undergone a miraculous change, and what was presented to us was a wonderful sight. On the higher ground *Drosera erythrorhiza* subsp. *erythrorhiza*, *Drosera menziesii* subsp. *menziesii* and *Drosera erythrogyne* grew scattered amongst the burnt remnants of the shrubs. Below this was an open wet slope of swampy area covered in *Cephalotus follicularis*, *Drosera binata* and *Drosera hamiltonii*. The fire had consumed all the hedge growth and left bare ground exposed; all the carnivorous plants had taken full advantage of the extra light and lack of competition.

The *Cephalotus* plants were still relatively small, but there were thousands of small clumps consisting of up to twenty pitchers appearing in all parts of this area. Entwined amongst the *Cephalotus* plants were just as many *Drosera binata* plants with their unique sticky forked leave. The soil was silica sand combined with a black humus peat moss that was wet enough to have water ooze from under our feet. Moving further down the slight slope, the plants seemed to grow in specific zones. At the highest area where there was no free water and the soil was a high percentage of sand; these areas supported only a few *Cephalotus* and these were badly dehydrated by the summer drought. Then there seemed to be a strip that was wet but did not have free water on the surface. This middle area was where *Cephalotus*, *Drosera binata*, *Drosera hamiltonii*, all grew together in masses. The lower area was very wet and only large *Drosera hamiltonii* grew here, some reaching 7-8cm diameter (see Figure 2A). Many were flowering and their metre high scapes with large mauve flowers could be seen scattered throughout (see Figure 2B). Very few of the *D. binata* were flowering (see Figure 2C), but new plants were freely appearing from their root systems.

We must have taken 500-600 digital photos and Chris was very active with his video camera. I made a mental note to revisit the site when the *Cephalotus* were flowering. Darren and I parted company with Chris and Gabri as they continued their holiday along the south coast.

It was not until early March 2004 that I managed to find time to make the eight hour round trip again. It was late in the season, and I was aware that the trip was probably a bit late to coincide with the flowering of the *Cephalotus*. This plant normally flowers around late December through February, the hottest part of the year.

When I stopped my old trusty four-wheel drive truck on the bush track that ran along the edge of this swamp, I was not prepared for the sight that unfurled. The vegetation had started to regenerate so the *Leptospermum*, *Acacia* and *Reedia* created a thick cover about 40-100 cm high.

Figure 1: Phill Mann and Robert Gibson. Photograph by Phill Mann.

Interspersed throughout were thousands of *Cephalotus* flowers in all stages of development. I had never seen so many *Cephalotus* in flower at one time like this. While on previous trips many of the plants were hidden, the location of each was now signalled by their flower scapes (see Figure 2D). The flower scapes showed all stages of development from un-open buds to shedding ripened seed (see Figure 2E). I did not see any pollen on the stamens, but by the amount of seed set, it must have been abundant. The pitchers were nearing mature size of 4-5cm and with the full sunlight, all had taken a beautiful range of colours from red through to deep maroon and nearly black (see Figure 2F).

All around was a constant movement of insects as they flew from one spike to the next. I was amazed at the number of different pollinators of the *Cephalotus*. I counted at least seven species of ants that stopped long enough for me to identify as being different, I saw nine species of flies ranging in size from only 2-3mm long, to the large 4cm long "March" flies that bite us so hard. I also saw two species of small pale blue-grey butterflies, and four or five beetle species.

Another interesting observation was the occurrence of a small evergreen dodder (*Cassytha sp.*, Lauraceae), a parasitic vine that was entwining and parasitising the *Cephalotus* scapes. Wherever the twining dodder stems contacted the flower stalks the parasite "foot" was quite obvious and solidly attached (see Figure 2G, also see the tendril in Figure 2E). This is the first recorded observation of dodder parasitising *Cephalotus*.

Scattered amongst the reeds in the very wet lower margin of the swamp, were many hundreds of *Utricularia paulineae* scapes with pastel mauve flowers (see Figures 2H, 2I), and several plants had white flowers (see Figure 2J). The *Utricularia* leaves were very obvious as they covered the wet surface thickly. Where they grew in watery depressions the traps could be seen floating with the leaves.

Moving back and forth taking so many photos, thanks to the beauty of my digital camera, the hours had passed quickly. I still had the four hour drive home to face, so I set off along the bush track that skirted these swamp depressions. Countless thousands more *Cephalotus* scapes could be seen above the regenerating shrubs in these swamps.

Figure 2: A: *Drosera hamiltonii* rosette; B: *Drosera hamiltonii* flower; C: *Drosera binata* flower; D: *Cephalotus follicularis* in flower; E: *Cephalotus follicularis* shedding seed; F: *Cephalotus follicularis* pitchers; G: *Cassytha* parasitising *Cephalotus*; H: *Utricularia paulineae*; I: typical *Utricularia paulineae* flower; J: abnormal white *Utricularia paulineae* flower. All photographs by Phill Mann.

This area is deep within country that is part of the D'entrecasteaux National Park and will remain untouched forever. The only threats are the non-native pig population that uses these swamps as summer refuge and unscrupulous collectors. Luckily only a very small number of people know this location, and hopefully they will treasure it.

Acknowledgements

I would like to thank Robert Gibson for the pleasure of his company on these trips and for his assistance with this article. No permits were required to conduct the activities described in this report.

References:

Gricve, B. J. (ed) 1998, Droseraceae. How to Know Western Australian Wildflowers: A key to the flora of the extratropical regions of Western Australia: Part II Dicotyledons (Amarathaceae to Lythraceae) Second Edition, University of Western Australia Press in association with the Wildflower Society of Western Australia Inc., Perth, p. 58.

Barry Rice (barry@carnivorousplants.org): I want to remind all ICPS members who travel to carnivorous plants sites for research or pleasure to be mindful of all relevant laws regarding site visitation and plant collection. Some of these laws can be very difficult to understand, and the laws in many areas are quite restrictive. For example, visitors to Venus flytrap territory in North Carolina should be aware that collection of *Dionaea* on public land is prohibited without a permit, and even collection on private land must be done with the permission of the landowner (in writing, and not more than 180 days old). More details on this can be found at: http://www.ncplant.com

I visit many states in the USA with carnivorous plants in them. In the last year alone I have seen carnivorous plants in California, Louisiana, Mississippi, Alabama, Georgia, South Carolina, North Carolina, Connecticut, Rhode Island, Massachusetts, and Vermont—each of these states has different laws regarding collection. It can be very confusing! Even if you are usually only pursuing photographs or memories, as I do, the laws governing site access can be tricky too.

Plant collectors visiting *Pinguicula* habitat in Mexico face significant hurdles as well; in fact I have gotten so much conflicting information about this it seems that getting permits may require you to know the right person, and to have a collaborator within the country.

Those interested in collecting plants from Venezuelan tepuis have perhaps the greatest hurdles to overcome. I have been told that the following permissions, authorizations, and access contracts are required: 1)A plant collection permits from the Ministry of the Environment and the Fundacion Instituto Botanico de Venezuela; 2)A permit from the National Park Institute; 3)A permit from the indigenous organizations; 4)An authorization of a special tepui commission; 5)An authorization from the Ministry of Education and FONACIT; 6)A special access contract to the genetic resources, a general regulations called "Acuerdo de Cartagena." Email I have received from Dra. Argelia Silva at the Venezuelan ONDB-MARN (la Oficina Nacional de Diversidad Biológica, Ministerio del Ambiente y de los Recursos Naturales) indicates that even to visit some locations, permits #2, 3, and 4 from the above list are required.

By the way, you might be surprised to hear that some people are actually opposed to foreign visitors collecting plants for scientific or horticultural reasons. Terms such as "bioprospecting" or even "biopiracy" are used, and these indicate that there is a great deal of controversy or resentment in some circles.

It is the responsibility of every visitor to carnivorous plant territory to learn about the laws that apply to them. Unfortunately, neither the ICPS nor I can provide legal or bureaucratic advice; this is the responsibility of the traveler!

Mike Crenshaw (strmchsrmc@att.net) wrote about a discovery he made while on holiday on a lake in Wisconsin, USA: On Saturday, I was in a little paddleboat, exploring the bogs and swamps that cover about 50% of the lake, and as I was paddling along the north shore, I saw...a pitcher plant! The first thing I saw was the red bell-shaped flower rising above the grasses and brush. I got closer, and it was a beauty. I went back to the trailer and got my camera and took a picture of it. Then as I wheeled along the bog, I saw another plant, and photographed it, too. The more I paddled around the lake, the more plants I found; more pitcher plants than I could count were growing all over the north and east side of the lake! The next day I also found sundews! Yes! Sundews were everywhere (*Drosera rotundifolia*, of course.) They were growing on mounds of sphagnum moss, in muddy areas, and even on an old fallen tree in the lake. Believe it or not, when I told my parents about the plants, they suggested I should "go dig it up and take it home," but I told them: "No thanks! I would like to leave them there so they can eat those bugs out there and make more plants, I already have plants at home that I bought online." I said to Mother Nature, "Thank you, but, I already have that!" I hope you enjoyed reading this message and I hope to hear from you!

Comments on a Useful Pesticide

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Keywords: cultivation: pesticides.

I usually do not use pesticides in my horticultural practices—I find that pest problems for well-grown plants usually take care of themselves. This is particularly true for plants being grown out doors. However, terrarium plants are often very susceptible to bug infestations.

Last spring I returned several plants that had been wintering on my porch back into one of my 230 liter (60 gallon) terraria. I did not know it at the time, but one of the plants had contracted a few aphids. A few weeks later, I noticed the plant (and plants in two adjacent pots) were infested with the nasty little things. I manually removed the aphids as well as I could, but it was too late—within a month, aphids had spread to every one of the plants in my terraria, including various *Byblis*, *Dionaea*, *Drosera*, *Genlisea*, *Pinguicula*, *Sarracenia*, and *Utricularia*. Plants were producing grotesquely deformed leaves. I was in trouble!

Staff at the University of California Botanical Conservatory told me that an insecticide they use with success on carnivorous plants (i.e., it killed the pests and not the plants!) contained the active ingredient Imidacloprid. This systemic insecticide resides in the plants for a few weeks, and even translocates short distances within the plant, so you do not have to actually spray the pest itself for the compound to be effective. If the pests are on the underside of a leaf, and you spray the top surface, you can have reasonable expectation that the pests will be killed.

After prowling the aisles in a number of garden supply stores, I found a pesticide marketed by Bayer called "Rose and Flower Insect Killer (ready to use)" that contained 0.012% Imidacloprid and 0.003% Cyfluthrin. I was concerned about the presence of the Cyfluthrin—which I knew little about, and also the 99.985% "other ingredients" in the product which were trade secrets that I knew absolutely nothing about. However, it was an emergency situation! I took the risk, and over the next few months I used the product on all the plants in both of my terraria (including all the genera listed above, as well as on *Heliamphora* and *Cephalotus*). I removed the plants from the terrarium and sprayed them so the plants were completely wet. I let their leaves dry overnight before returning them to the terrarium. The results have been excellent. All the pests were killed, and no short-term or long-term damage to the plants was observed.

Several months have passed; the bugs are still gone and the plants are doing fine. However, I have observed three side effects. First, the aquatic bladderworts (*U. inflata*, *U. gibba*) that once thrived in the several centimeters of water in the bottom of my terraria have slowly perished. Furthermore, the tiny aquatic invertebrates (copepods, daphnia, etc.) that lived in the water also died, while the filamentary algae are growing more rapidly. I presume that the growth of the algae is due to the absence of microscopic herbivores. I have no proof that these effects are due to the insecticide applications, but I have my suspicions. Finally, John Brittnacher and I have both seen Imidacloprid-related damage to *Dionaea* plants (distorted leaves, some browning), however, the plants were not killed or set too far back (although one plant out of about 25 did indeed die). I will be cautious about using this insecticide on *Dionaea* in the future, but will probably apply it to plants newly arrived from other collections.

If you are interested in trying these insecticides on your plants, you can consider my results to be promising pilot work. The "Rose and Flower Insect Killer (ready to use)" has the EPA Registration Number 3125-504-72155. I also successfully used a similar product by Bayer called "Rose and Flower Insect Killer (ready to spray)," which has the EPA Registration Number 72155-7. The "ready to spray" formulation's bottle is designed to be fit onto a hose-end applicator; when used this way the product is applied via garden hose at the correct concentration. When I used this product, I manually diluted it with purified water: 1 part concentrate to 29 parts water, resulting in a mix with active ingredients in the concentrations of 0.012% Imidacloprid

and 0.012% Cyfluthrin. (If you are inexperienced with laboratory practices, you should probably stick with the "ready to use" formulations.) You can view the product labels for these products at:
http://www.bayeradvanced.com/pg/pg_gp.html (a general web page),
http://www.bayeradvanced.com/pg/PDFs/rfik_rtu.pdf (for the ready to use product),
http://www.bayeradvanced.com/pg/PDFs/pgRoseFlowerRTS.pdf (for the ready to spray product).

If you cannot find these products in your country, perhaps you can find a similar product with the same active ingredients. I cannot promise that other formulations of these insecticides will be as useful for pest control on carnivorous plants, but they might be a solution you are looking for.

I feel compelled to remind you of three caveats. First, tread carefully whenever using industrial compounds on your plants. Even if the "active ingredients" may be safe on your plants, the other mysterious "inert ingredients" might be harmful to them. Apparently for the products mentioned above, the formulations are not harmful to carnivorous plants (except, perhaps, to *Dionaea* and some aquatic *Utricularia*). Second, when using any compound such as these insecticides, make sure you follow all appropriate safety precautions as described on the product label. Third, use these compounds sparingly. Since the active ingredients may take more than a few weeks to degrade naturally, they may pollute the environment. If these chemicals start appearing in groundwater tests, it is likely they will become prohibited, as has happened to other pesticides that were overused.

Literature Reviews

Forterre Y., J.M. Skotheim, J. Dumais, and L. Makhadevan L. 2005. How the Venus Flytrap Snaps. Nature 433: 421-425.

The title of this paper should rather be "a mathematical model for the phenotype of venus flytrap closure". Here we finally have a geometrical definition of the comparatively obvious fact that the most wonderful phenomenon in the carnivorous plant world does not rely on the trap lobes folding upon each other along the midrib acting as a hinge (cf. the *Mimosa* pulvinus) but rather on the change of the conformation of the lobes from a convex to a concave state. The physiological processes in the lobe tissues inducing that change are most unfortunately still not elucidated by this piece, although the rather exaggerated publicity around it might have suggested such. The good news is even utterly descriptive work may (contrary to widespread belief) still be published in popular journals. (JS)

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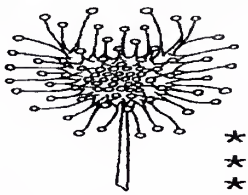

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YOUTHWORT—HERBAL ALCHEMY

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Keywords: history, practical uses: *Drosera.*

All that glitters is not gold; often have you heard that told.
—William Shakespeare, the Merchant of Venice 1597

Introduction

Youthwort is an unfamiliar albeit quite old name for the sundew plant. There is an intriguing reason for how it must have gotten this curious name. Historically the sundew is associated with alchemy. The name "youthwort" is obviously derived directly thereof; and as you will see, "sundew" may possibly be as well. Rather surprising are the implications; they suggest that extract of sundew was apparently the fabled Philosopher's Stone and Elixir of Life! During the Middle-Ages alchemists found a more practical application as well for which it continues to be used today. There is certainly far more to the history of the sundew than the average person would imagine.

Most people know at least a little about alchemy, which is the ancient study that led to modern chemistry and pharmacology. Paracelsus, 1493-1541, was an eminent Renaissance figure in alchemy at a time when the practice was becoming truly scientific. Paracelsus was the first to use the word "chemistry" which was then known as the "art of distillation" (Pachter, 1951). Paracelsus also coined the term spagyrics which is basically herbal alchemy.

Alchemy is not only an archaic practice, as you might expect—there are present day practitioners. So while I may sometimes write this article in the past tense, there are those who believe in its tenets even today! (And I have also read fanciful stories of immortal adepts, such as Count de Saint-Germain, from ancient times, purportedly living today!)

Philosopher's Stone and the Elixir of Life

Most interesting is the alchemist's *Magnum Opus* (Great Work, not a book) which treats (among other things) the manufacture of Philosopher's Stone. What is Philosopher's Stone composed of? This is alchemy's greatest secret. It is not necessarily a stone—it might be a solid, liquid, or powder (Time, 1990). Philosopher's Stone is used in the transmutation of cheaper metals into gold. (Gold has special significance in alchemy because, unlike many other metals, it does not tarnish. As such, it was viewed as incorruptible, and alchemists were certain it is related to immortality.) The liquid state of Philosopher's Stone is the Elixir of Life, which of course is reputed to restore youth. This liquid is a gold tincture (medicinal solution in alcohol; for tinting) and, like the saying that "all that glitters is not gold," the Elixir is not usually made out of gold, but is typically only golden in color (Time, 1990). The 13th century Dominican monk Albertus Magnus warned about "deceivers" tinting lesser metals gold (Time, 1990). As you will see, sundew extract at one time seems to have been such a tinting agent.

Sun and Dew

There are many books showing illustrations depicting the manufacture of Philosopher's Stone and of the transmutation of base metals into gold. These give intriguing clues to the symbolic alchemical significance of sundews. Alchemical illustrations are allegorical, in order to be intentionally cryptic so the alchemist's secrets could be kept hidden. For example, one such arcane book important in alchemy is named the *Mutus Liber* (Mute Book, first published in 1677), since it has few words. Only an adept alchemist could fully interpret these enigmatic texts.

Two important symbols which were common and are now well understood were the Sun, and

oddly enough, dew. The Sun corresponds with gold among the seven "Hermetic Metals". Dew was considered a divine fluid and constituted the *prima materia* of the alchemical process (Time, 1990). Alchemists were frequently depicted as collecting dew as part of their essential activities, as shown in the *Mutus Liber*. A cloth was drawn over the ground and the dew was then wrung out into suitable containers.

The *Mutus Liber* demonstrates the perceived importance of dew in giving reference to certain Bible passages. These are Genesis 27:28, 39 and Deuteronomy 33:13, 28. Briefly stated, dew was thought to be Heaven-sent. Making use of dew and other substances was an alchemical tradition of attempting to recreate the essence of the biblical Tree of Life. This is elaborated in the Ripley scroll, which is attributed to fifteenth century English monk George Ripley (Time, 1990). A golden tree symbolizing the Tree of Life occurs frequently in Paracelsus' works as well (Pachter, 1951).

Not all the divine dew collected was a result of condensed water vapor—some was produced by plants exuding water (a process known as guttation). One extraordinary producer of dew is lady's mantle (*Alchemilla vulgaris* L.). The genus name *Alchemilla* was derived from the word alchemy by Linnaeus precisely for this reason (Reader's, 1986). This plant was used by alchemists in the attempted production of Philosopher's Stone and Elixir of Life (Reader's, 1986).

An old herbal work I was able to find provides proof that the sundew was in all likelihood another herb used to create Philosopher's Stone, and was used in medicine as well. Gerard's Herbal was first printed in England in 1597, and is frequently republished (in part, at least). The Herbal described two sundew species—*Drosera intermedia* Hayne and *D. rotundifolia* L.—both with the common name "youthwort." Pre-Linnaean names for these plants are given respectively as *Ros Solis folio oblongo*, and *Ros Solis folio rotundo*. In Medieval Latin the word *Ros* translates as dew, while

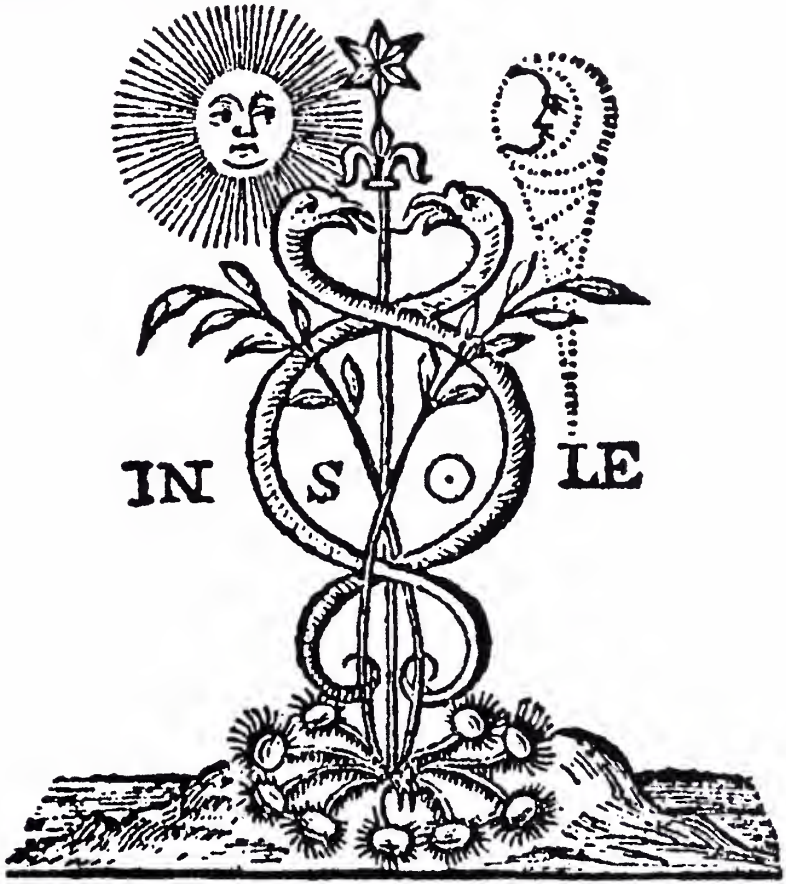

Figure 1: Early seal of the spagyric laboratory 'Soluna', founded in Germany 1921. *In Sole, Latin* = In Sun.

Solis of course translates as sun. Here we find the two most important symbols in alchemy together: Sun-dew.

The purported herbal tonic usage for sundews is as follows: "It strengthens and nourishes the body especially if it is distilled into wine, and that liquor thereof which the common people do call *Rosa Solis*." The aforementioned alchemic connections are suggested as well: "The distilled water hereof that is drawn forth with a glass still, is of a glittering yellow color like gold, and colors silver put therein like gold". —Note the reference to the gold color; hence golden tincture or Philosopher's Stone! A more recent source shows a golden "tincture" extract of *D. rotundifolia* (Polunin, 1992). Also note in Gerard's Herbal that the gold-tinted metal appears to be the sort of deceptive false gold mentioned previously.

Gerard's Herbal continues: "Later physicians have thought this herb to be a rare and singular remedy for all those that have consumption of the lungs, especially the distilled water thereof. For as the herb does keep hold fast to the moisture and dew..." As early as the 13th century, alchemists (yes, the book states "alchemists") had recorded positive results from the use of sundew extract in the treatment of consumption of the lungs, or tuberculosis (Reader's, 1986).

Nowadays this property of the sundew is used primarily as an expectorant in cough medicine (Fluck, 1988). The constituent is plumbagine and hydroxy-plumbagine (=droserone). So we see that old herbals record magical usage by alchemists, and medical usage by physicians. In both magic and medicine the sundew was esteemed for its dew.

Another book, Green Magic (Gordon, 1977), gives basically the same information and contains a little more: Silver put into the water distilled from the sundew turns golden. In Italy was made a kind of liqueur called Rossoli. The sundew was used as a remedy for that all too common illness—old age; hence the moniker youthwort. Remember, a tincture is an alcoholic solution. Obviously *Rosa Solis* and Rossoli are related to the Elixir of Life. As you can see, it was in use over a wide area, from at least England to Italy. Oxford English Dictionary tells that the alcoholic drink was known in France, Portugal, and Spain as well.

Finally, in my quest for information I was amazed to find an illustration (see Figure 1) with classical alchemical symbols which features *D. rotundifolia* (Roob, 2001). Surprisingly in this one the serpents of the *caduceus* are entwined around the inflorescence of the sundew. More commonly serpents are shown clinging to the Tree of Life. The originator of the seal, Alexander von Bernus, was very interested in the work of Paracelsus. I wonder what secrets he may have uncovered.

Closing Remarks

Should you choose to use sundew extract as a medication, please be advised to use as prescribed. What is the efficacy of youthwort, does it really work? According to alchemists, the answer would be a resounding YES. It is fun to imagine that perhaps modern science might rediscover some secret property of our precious glittering sundew. However I would not suggest you drink a beverage of it in hope of restoring youth. It may actually be quite toxic. Do not be deceived, it certainly does not have the power to transmute metals! I would like to close this article with a quote from Paracelsus' first public lecture: "The end of alchemy is not to change lead into gold. The end of alchemy is to find new ways to heal." (Susac, 1969)

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Scott Bennett's Carnivorous Plant Prints

Reviewed by Carl Mazur

Prints of botanical artwork have become quite chic. Over the years I have collected a small collection of hand-painted carnivorous plant prints from the 1800s. This can be a very expensive hobby; depending upon the age and size of the prints, they cost about 150 USD or more, even for prints only 13 × 18 cm (5 × 7 inches) in size! Even though I love these antiques, I am reluctant to display them for fear of UV damage or other mishaps. While they can be framed so they are protected from damage, doing this can be quite costly—even more so than the actual artwork! I have tried cost effective alternatives such as digitizing them and printing them out on photo paper. Unfortunately, within six months they began fading. Little did I know that a cost effective alternative was going to present itself from an old connection I made many years earlier.

In the early 1990s, I was invited to an informal carnivorous plant get-together in a small town in upstate New York. It was there that I had the privilege of meeting Scott Bennett. He had brought paintings of *Pinguicula gypsicola* and *Cephalotus follicularis*. Scott works in watercolor and gouache on hot press watercolor paper. While I do not remember much of Scott during this meeting, other than a quick handshake and a casual "hello, nice to meet you," the images of those paintings have been ingrained in my mind ever since. I was amazed at the level of detail in his paintings. Every detail was painstakingly reproduced with incredible accuracy. They were truly amazing paintings. On my drive home I kept thinking to myself, "Man, I would love to own one of those." Then reality would set in; like most other original works of art, they were way out of my financial reach. So being the practical sort that I am, I filed the dream of owning one of these masterpieces away for a another day—or at least, for a less financially challenged day.

That was over ten years ago, and like most dreams, they had faded with time. But my interest in Scott's illustrations and paintings was rekindled when many of his works were used in Peter D'Amato's book. I contacted Scott to see if he had prints available, and to my surprise he informed me that he was working the bugs out of a new print process to make his prints easily affordable.

Scott is marrying the traditional world of watercolor painting techniques with the new world of digital imaging technologies. He uses ultrahigh-resolution scanners to digitize his original artwork, then carefully removes any imperfections and color corrects them. After he adds a background color and supporting text, the layout is complete. Scott also runs a series of test prints so he can make any final image adjustments to each image before choosing the final production print.

Using this method, the prints can be created on demand—when a particular print is requested, Scott simply prints it out onto 100% mould-made cotton fiber acid-free lignin paper that is chlorine-free and pH buffered with calcium carbonate. The results from this eight-color ink jet technology will not fade when displayed under glass and exposed to average indoor light levels, and have archival qualities for up to 100 years. Before being shipped, Scott inspects each print, signs and dates it, and embosses it with his chop mark indicating his inspection of the print, which adds final authority to the origin of the print.

Needless to say, after talking to Scott about his prints I was very curious about the quality. I remembered the *Pinguicula* and *Cephalotus* paintings I saw all those year earlier. I was interested to see how the prints would compare. Scott was kind enough to send me a number of prints to inspect, and one of them was the *Pinguicula* I remembered so well. The largest was printed on 69 × 43 cm (27×17 inches) paper, with an image size of 60 × 29 cm (23.75 × 11.30 inches). I was most curious about the quality of the large prints because any image degradation would be most visible on these: the images were tack sharp and vibrant. I am not an expert on paper, but it is clearly a solid, high quality material. I was convinced of the high quality of the prints.

The last thing to consider was the price. Scott's prints are very affordable (certainly more so than my antique prints!). The largest print size that Scott offers (described above) is only 90 USD. His smallest print, 32 × 21 cm (12.5 × 8.25 inches) is only 35 USD. And since these prints are not completely irreplaceable antiques, you should have no problem hanging them up!

Scott's method of producing prints is a win-win for both artist and consumer. It gives Scott the ability to increase the number and variety of prints that he can make available and gives the consumer a high quality piece of artwork at an affordable price. If you are interested in buying a print, you can visit his website (www.scottbennettart.com). You can also find information about the latest release of Scott Bennett's prints on the ICPS website at www.carnivorousplants.org/latestnews/bennett/printrelease.htm.

Figure 1: Four of Bennett's illustrations. These images have been cropped slightly to fit Carnivorous Plant Newsletter's page dimensions; the black borders were added to help separate the images.

A Veinless Form of *Sarracenia purpurea* subsp. *purpurea* Discovered in Ontario, Canada

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Keywords: Field studies: Ontario (Canada), pigmentation, *Sarracenia purpurea* — Genetics: *Sarracenia purpurea*.

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In June 1997, we visited a *Sphagnum* lake-margin bog in Grey County, Ontario, Canada. This 5,000 square meter site contains a population of the typical (i.e. intensely red-pigmented) form of *Sarracenia purpurea* subsp. *purpurea* common throughout the Great Lakes region. During this trip, we discovered a previously undocumented population of the anthocyanin-free *Sarracenia purpurea* subsp. *purpurea* f. *heterophylla*. The two grow intermixed on the floating *Sphagnum* mat (see Figure 1).

During this and subsequent field trips to this location, we observed pitcher plants that superficially resemble *Sarracenia purpurea* subsp. *purpurea* f. *heterophylla*. The current season pitchers of these plants are yellow-green to almost pure yellow (when growing in full sun), and look very much like the anthocyanin-free form. However, the growing points exhibit coloration typical of the normal, red-colored *S. purpurea* subsp. *purpurea*. Furthermore, over-wintered pitchers are often suffused with pale pink. During the flowering season, the petals on these strange plants range in color from almost pure yellow to the deep maroon typical of *S. purpurea* subsp. *purpurea*. Some flowers exhibit pinkish to red streaking on yellow petals.

In addition, we have observed yet other plants with peculiar pigmentation patterns worthy of comment, that could be described as being intermediates. In summary, in our 1997-2001 observations (made at various times of the year), we have noted four distinct color variants of *S. purpurea* subsp. *purpurea* in the bog:

1—The typical form of *Sarracenia purpurea* subsp. *purpurea* plants with intensely red leaf venation and red flowers (see Figure 2). This is the pigmentation pattern that Sheridan & Scholl (1996) referred to as "red".

2—The anthocyanin-free form, *Sarracenia purpurea* subsp. *purpurea* f. *heterophylla* (see Figure 3). Red pigmentation is absent from all the plant's parts. Sheridan & Scholl refer to this form as "green."

3—Plants exhibiting only marginal red coloration (see Back Cover). Upon casual viewing, these clones resemble "green" plants. Closer examination, however, finds slight red pigmentation in the growth point (typically buried by *Sphagnum*, and occasionally in the leaf margin, ringing damaged portions pitchers and suffusing aged pitchers from the previous growing season. Petal color is highly variable, and may be green, pink, red, yellow streaked with red, or other intermediate patterns. The red pitcher venation so typical of "red" plants is always absent. As such, we have coined the term "veinless" (that is, lacking red venation) to describe these plants, to augment the terminology used by Sheridan & Scholl (1996).

4—This category contains the range of plants that are intermediate between the "red" plants and the "veinless" plants, with varying degrees of venation. We have coined the term "semi-veinless" to denote these plants. Examples of semi-veinless plants are shown in Figures 4, 5 and 7.

Figure 1: An open *Sphagnum* bog in Grey County, Ontario, Canada. Note the intermixed color variants of *Sarracenia purpurea*. Photograph by Carl Mazur.

Figure 2: Red *Sarracenia purpurea* at Grey County, Ontario, Canada. Photograph by Carl Mazur.

Figure 3: Green *Sarracenia purpurea* at Grey County, Ontario, Canada. Photograph by Carl Mazur.

Figure 4: Semi-veinless *Sarracenia purpurea* at Grey County, Ontario, Canada. Red pigmentation and venation is prominent, but not as intense as in normal red plants. Photograph by Carl Mazur.

Figure 5: Semi-veinless *Sarracenia purpurea* at Grey County, Ontario, Canada. Red venation is nearly absent, but a slight pitcher blush of orange is still visible, especially on the margins of the pitchers. Photograph by Carl Mazur.

In July of 1997, one of us (CM) and Dino Petruzzi conducted a census of the plants in a portion of the bog at the Grey County site. Ten 2.25 m^2 quadrats were selected that appeared to be representative of the entire bog. A total of 184 plants were classified by color type as described above. Only plants mature enough to clearly indicate their pigmentation class were included in the count; immature plants do not express sufficient pigmentation characteristics to ensure accurate classification.

The veinless form predominated, comprising more than two-thirds of classified plants (see Figure 6). Only six percent of the examined population consisted of red plants, and only one percent of the examined population consisted of green plants. Approximately one-fourth of the plants consisted of semi-veinless plants.

We have observed an additional bog exhibiting similar color variability in Huron County, Ontario, Canada, approximately 100 kilometers from the Grey County site. Here, the red form of *S. purpurea* subsp. *purpurea* dominates. However, green, veinless, and semi-veinless color forms are also present. Color variability has also been reported in bogs in Northern Michigan (Case, 1956; Shomin, 1993).

The Visual Case for Hybridization

So far, forms of *Sarracenia* subsp. *purpurea* lacking red venation have only been observed in the company of *S. purpurea* subsp. *purpurea* f. *heterophylla*. It is therefore plausible that these "veinless" plants are the result of hybridization between red and green plants. This hypothesis is further supported by the spatial distribution of the color forms in the Huron County location. While red

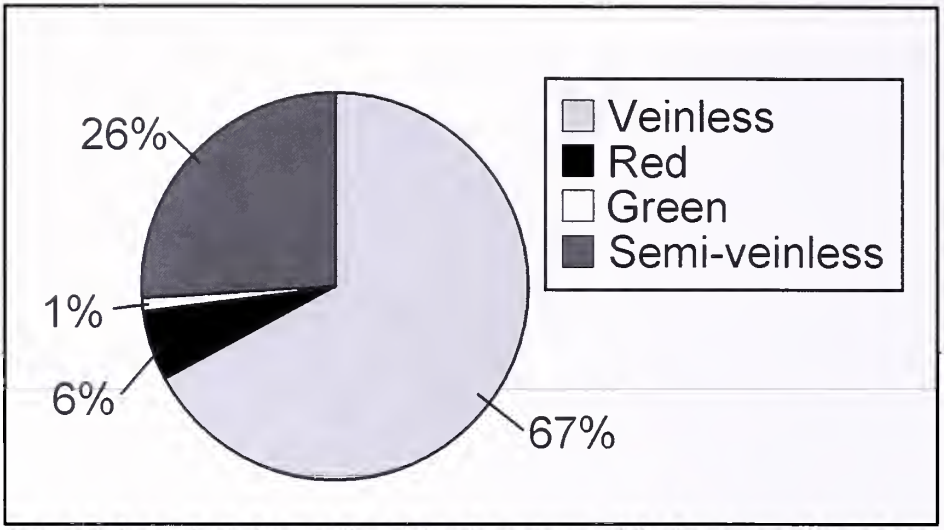

Figure 6: A pie chart showing the relative frequencies of the four pigmentation types of *Sarracenia purpurea*, as observed in a bog in Grey County, Ontario, Canada.

plants dominate at this site, there are localized areas, approximately 10-50 meters in diameter, where other color forms are more prevalent or even locally dominant. At the centers of these areas, there are typically one or more green plants. In the immediate vicinity of these green plants is a higher occurrence of veinless plants. As the distance from cluster core increases even more, semi-veinless plants become more common (and the degree of red pigmentation in these appears to increase with increasing distance from the cluster core). This is not to say that the green, veinless, semi-veinless, and red plants form clearly delineated concentric rings around the cluster core; rather, the frequency of semi-veinless and veinless plants increases closer to the green plants.

In September 2000, one of us (CM) visited a *Sarracenia purpurea* subsp. *purpurea* bog in Wellington County, Ontario, with Phil Wilson and Melissa Burgio. While this bog was dominated by red plants, one green plant was located. Other plants near the green specimen exhibited less-apparent red venation and more yellow color to the leaf than is seen in red specimens. This was a case of a green plant associated with semi-veinless plants.

Interestingly, a nearly opposite color distribution pattern can be found in the Grey County bog, where the locally-rare red plants can be found in the center of areas of semi-veinless plants. As the distance from isolated red plants increases, the frequency of intermediate plants decreases, gradually blending into the locally-abundant veinless plants. Perhaps the process of hybridization in this site has been occurring for so long that the red plants have blended with the veinless or semi-veinless plants. Even more interesting is the possibility that the red plants have been out-competed by semi-veinless, veinless and green competitors. It has been suggested, at least in the case of *S. rubra* subsp. *jonesii*, that green clones out-compete their red counterparts for prey, and enjoy a resulting increase in growth and vigor (P. Sheridan, pers. comm.). Perhaps a similar effect may be happening at the Grey County bog with *Sarracenia purpurea* subsp. *purpurea*.

Other Examples of Intermediate plants

Occurrences of veinless and semi-veinless plants are not restricted to Ontario *Sarracenia purpurea* subsp. *purpurea* sites. Similar pigmentation patterns have been observed in other *Sarracenia* populations. We have observed veinless and semi-veinless specimens of *Sarracenia rosea* plants among normal, red *S. rosea* plants in Bay County, Florida. One of us (JL) has observed populations of *Sarracenia psittacina* in Gulf County, Florida that contained green, veinless, semi-veinless and red plants.

Finally, we have observed *Sarracenia minor* sites, in Ware County, Georgia and Berkeley County, South Carolina, that include veinless and semi-veinless specimens among the red plants.

Figure 7: Semi-veinless *Sarracenia purpurea* at Grey County, Ontario, Canada. Red venation is nearly absent, but an orange-red blush on the pitchers is still evident. Photograph by Carl Mazur.

Sheridan & Scholl (1997) suggest that the green trait in *Sarracenia* is consistently recessive, and Sheridan & Mills (1998) demonstrated that crossing red plants with green plants resulted in red phenotypes that carry the recessive green gene in the F1 generation. Furthermore when they crossed F1 plants they obtained the expected genetic ratio of 3:1 red to green offspring with no intermediates. However Sheridan's experiments do not appear to be consistent with our field observations.

Note: Permissions to access to the sites described in this report were kindly provided by the Saugeen Valley Conservation Authority and the Hamilton-Wentworth Conservation Authority.

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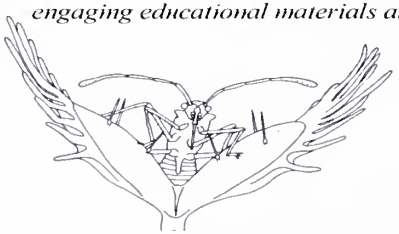

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New Chromosome Numbers for *Drosera* L.(Droseraceae)

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Keywords: karyology: *Drosera*.

Introduction

Out of nearly 150 known *Drosera* species, chromosome numbers are known for approximately 50 (Bennett & Cheek, 1989; Behre, 1929; Beuzenberg & Hair, 1983; Debbert, 1987; Heitz, 1926; Hoshi & Kondo, 1998a, 1998b; Kondo, 1969, 1971, 1973, 1976, 1984; Kondo & Lavarack, 1984; Kondo & Olivier, 1979; Kondo & Segawa, 1988; Kondo & Whitehead, 1971; Kress, 1970; Peng *et al.*, 1986; Rothfels & Heimburger, 1968; Schlauer, 1987; Sheikh & Kondo, 1995; Venkatasubban, 1950; Wood, 1955) in almost all subgenera and sections *sensu* Schlauer (1996). A summary of chromosome numbers previously published for *Drosera* taxa is presented in Table 1.

Most of the New World *Drosera* species belong in subgen. *Drosera* (sections *Drosera*, *Oosperma*, and *Ptycnostigma*) except *D. meristocaulis* Maguire & Wurdack and *D. sessilifolia* A.Saint-Hilaire which belong respectively in the subgenera *Meristocaulis* and *Thelocalyx* (Schlauer, 1996). All chromosome numbers known for subgen. *Drosera* are multiples of the basic number x=10, including 2n=20, 30, 40, 60, and 80 (Bennett & Cheek, 1989; Behre, 1929; Beuzenberg & Hair, 1983; Debbert, 1987; Futagawa, *et al.*, 2002; Hoshi & Kondo, 1998a, 1998b; Kondo, 1969, 1971, 1976; Kondo & Lavarack, 1984; Kondo & Olivier, 1979; Kondo & Segawa, 1988; Kress, 1970; Peng *et al.*, 1986; Rothfels & Heimburger, 1968; Venkatasubban, 1950; Wood, 1955). The only exceptions are *D. adelae* F.Muell., *D. cuneifolia* L.f., and *D. indica* L. (see Table 1).

All of the taxa native to North America (excluding simple hybrids) have 2n=20 (Futagawa, *et al.*, 2002; Hoshi & Kondo, 1998a, 1998b; Kondo & Segawa, 1988; Rothfels & Heimburger, 1968; Wood, 1955), except *D. anglica* Huds. which has 2n=40 (Kondo & Segawa, 1988; Wood, 1955). Among these, three species also occur in Europe and temperate Asia (*D. anglica* Huds., *D. intermedia* Hayne, and *D. rotundifolia* L.) and three in South America (*D. brevifolia* Pursh, *D. capillaris* Poir., and *D. intermedia*) (Diels 1906; Schlauer 1987).

New chromosome numbers for *Drosera* species are reported below and the karyology of the genus is discussed and compared to recent molecular data.

Materials and Methods

Only meristematic tissue from live root tips (collected from plants in the wild or in cultivation) were used for chromosome counts. Mitotic arrests were acomplished with 8-hydroxyquinoline (0.002M for 3-5h in the refrigerator) and methanol/glacial acetic acid (3:1) was used for fixation. Root tips collected in the field were fixed directly in methanol/acetic acid (3:1). Standard chromosome preparations (HCl/ Giemsa) followed Guerra (1983).

A list is given in Table 2 of the taxa native to areas south of the Amazon Basin in Brazil that were karyologically analyzed, as well as their chromosome numbers, and respective herbarium voucher specimens. In Table 3 are the ehromosome numbers and origins of the taxa analyzed which were grown from seed or vegetatively propagated.

Results and Discussion

Chromosome numbers for all taxa in Table 3 have been previously reported by other authors, the only exception being *Drosera roraimae*, which has been found to have 2n=20. The chromosome counts carried out for *D. capensis* L., *D. intermedia*, and *D. filiformis* Raf. var. *tracyi* (Macf.) Diels (respectively 2n=40, 2n=20, and 2n=20) agree with those published by other authors (Behre, 1929; Heitz, 1926; Hoshi & Kondo, 1998a; Kondo & Segawa, 1988; Rothfels & Heimburger, 1968; Wood,

Subgenus / Section	Approximate # of species	Distribution	Chromosome numbers
Thelocalyx	2	S Asia, N Australia, S America	20
Arcturia	2	SE Australia, N.Zealand	20
Stelogyne	1	SW Australia	28
Meristocaulis	1	N Brazil, S Venezuela	unknown
Regiae	1	South Africa	34
Coelophylla	1	S Australia	22
Lasiocephala	13	N Australia, N.Guinea	12, 13, 14, 19, 24
Drosera / Prolifera	3	NE Australia	28, 30
Drosera / Arachnopus	1	Africa, Asia, Australia	28
Drosera / Ptycnostygma	7	South Africa, New World	20, 40, 60, 80
Drosera / Oosperma	24	Worldwide	20, 40, 60, 80
Drosera / Drosera	20	Africa, Asia, Europe, New World	20, 32, 40
Bryastrum / Bryastrum	1	S Australia, N.Zealand	*c.*28
Bryastrum / Lamprolepis	29	SW Australia	6, 10, 12, 14, 16, 18, 20, 28
Phycopsis	1	E Australia, N.Zealand	32, 46, 64
Ergaleium / Ergaleium	23	S & E Asia, Australia, N.Zealand	14, 26, 28, 30, 32, 40
Ergaleium / Stolonifera	4	SW Australia	20, 26

Table 1: Chromosome numbers for the genus *Drosera* (Bennett & Cheek, 1989; Behre, 1929; Beuzenberg & Hair, 1983; Debbert, 1987; Futagawa, *et al.*, 2002; Heitz, 1926; Hoshi & Kondo, 1998a, 1998b; Kondo, 1969, 1971, 1973, 1976, 1984; Kondo & Lavarack, 1984; Kondo & Olivier, 1979; Kondo & Segawa, 1988; Kress, 1970; Peng *et al.*, 1986; Sheikh & Kondo, 1995; Venkatasubban, 1950; Wood, 1955) with the distribution (Diels, 1906; Schlauer, 1987) and number of species in each subgenus and section *sensu* Schlauer (1996).

1955). *D. cistiflora* L. has been reported to have 2n=40 (Kondo & Olivier, 1979) and 2n=60 (Behre, 1929), this variation not being a surprise considering it is one of the most morphologically polymorphic species in the genus. For this study, a purple-flowered form of *D. cistiflora* was found to have 2n=60.

Both Rothfels & Heimburger (1968) and Behre (1929) published 2n=80 and Heitz (1926) 2n=*c.*72 for *D. spatulata* Labill., the highest chromosome numbers known in the genus *Drosera*. These specimens were later considered synonymous of *D. aliciae* Hamet (Kondo, 1971). The number reported by Heitz was most likely obtained from 2n=80 specimens, the confusion arising from the difficulty of counting the tiny chromosomes found in polyploid species of subgen. *Drosera*. Bennett & Cheek (1989) published 2n=40 for *D. aliciae*, a number confirmed in the present work. The question stands whether *D. aliciae* comprises both a tetraploid and an octoploid race, or whether two different taxa are involved (a very likely scenario, considering the taxonomic confusion involving small rosetted African sundews).

Among the rosetted African species is *D. cuneifolia*, which belongs to sect. *Drosera* (Schlauer, 1996) and is native to the Cape Town region of South Africa (Diels, 1906; Schlauer, 1987). Kondo & Olivier (1979) reported 2n=32 for this species, although Debbert (1987) found 2n=40 for *D. admirabilis* P.Debbert, which is considered a synonym of *D. cuneifolia* by Schlauer (1987). A new chromosome count for *D. cuneifolia* would be of interest to confirm (or refute) the above number.

For *D. spatulata* the chromosome numbers of 2n=20, 40, 50, and 60 have been reported (Beuzenberg & Hair, 1983; Hoshi & Kondo, 1998a, 1969, 1971; Rattenbury, 1957), excluding the

above-mentioned 2n=*c.*72 and 80 which pertain to *D. aliciae*. The *D. spatulata* specimens reported to have 2n=60 belong to what was later described as *D. tokaiensis*, the amphiploid hybrid between *D. spatulata* and *D. rotundifolia*. The specimens reported to have 2n=50 are most likely hybrids between *D. tokaiensis* and tetraploid *D. spatulata*. Thus the only chromosome numbers confirmed for true *D. spatulata* are 2n=20 in New Zealand and 2n=40 in Australia and Japan.

The odd 2n=30 obtained in this work for *D. spatulata* from Beerwah (near Brisbane, Queensland, Australia collected by Mr. Ivan Snyder) is a new number never before reported for *D. spatulata* and the specimens used are almost certainly hybrids between a tetraploid and a diploid race. Seeds obtained from these cultivated specimens did not germinate, suggesting that the plants were sterile. However it is uncertain whether the hybridization occurred accidentally in cultivation or naturally in the wild, since it is not known if diploid races of *D. spatulata* exist in Australia. The chromosome number 2n=30 is also known from other sterile hybrids between diploid and tetraploid *Drosera* species. (Kondo & Segawa, 1988), including the recently described *D. tokaiensis* subsp. *hyugaensis* J.Seno, a simple cross between *D. spatulata* and *D. rotundifolia* (Seno, 2003).

As with the majority of the North American taxa, several of the South American taxa have been found to be diploids with 2n=20. These are *D. cayennensis* Sagot ex Diels (here including *D. punila* Santos and *D. coloubiana* Fernandez-Perez as synonyms), *D. communis* A.Saint-Hilaire, *D. hirtella* A.Saint-Hilaire var. *hirtella*, *D. hirtella* var. *lutescens* A.Saint-Hilaire, *D. roraimae* (Klotzsch ex Diels) Maguire & Laudon, *D. sessilifolia*, and *D. viridis* F.Rivadavia. The South American *D. brevifolia* and *D. intermedia* here analyzed, similarly to other specimens studied (Futagawa, *et al.*, 2002; Hoshi & Kondo, 1998a; Kondo & Segawa, 1988; Wood, 1955), also have 2n=20 (Tables 2 and 3). Interestingly, *D. ascendens* A.Saint-Hilaire, *D. camporupestris* F.Rivadavia, *D. chrysolepis* Taubert, *D. grantsaui* F.Rivadavia, *D. graomogolensis* T.Silva, *D. tomentosa* A.Saint-Hilaire, and *D. tentaculata* F.Rivadavia were discovered to be tetraploids with 2n=40. The natural hybrid *D. grantsaui* × *D. tomentosa* was also found to have 2n=40, as in both parent species (Table 2). In agreement with Futagawa, *et al.* (2002), *D. graminifolia* A.Saint-Hilaire and *D. villosa* A.Saint-Hilaire were found to have 2n=40.

Drosera sessilifolia is here reported to have 2n=20 (Table 2), as does the only other member of subgen. *Thelocalyx*, *D. burmannii* Vahl. (Hoshi & Kondo, 1998b; Kondo & Lavarack, 1984; Peng *et al.*, 1986; Venkatasubban, 1950) (Table 1). *Drosera sessilifolia* is known to occur in Brazil, Venezuela, and Guyana (Schlauer, 1987) whilst *D. burmannii* occurs from Northern Australia to Southern and Eastern Asia (Diels, 1906; Schlauer, 1987) (a collection of *D. burmannii* from West Africa is cited in Diels, yet this has never been confirmed). Although geographically distant, *D. burmannii* and *D. sessilifolia* are very similar morphologically, differing in that the former has cuneate leaves, ascending scapes, and white flowers whilst the latter has cuneate-spathulate leaves, erect scapes, and pink-lilac flowers. Interestingly, fertile offsprings between these two species have been obtained through artificial hybridization in cultivation (Ivan Snyder, pers. comm.).

The chromosome number for *D. sessilifolia* has been reported as 2n=80 (Hoshi & Kondo, 1998b) and as 2n=20 (Futagawa, *et al.*, 2002). Seeds labelled as *D. sessilifolia* have been circulating in cultivation for a few years, yet the resulting plants are almost always *D. aliciae*, which also has 2n=80. Considering that *D. sessilifolia* crosses with *D. burmannii* (2n=20) and that these hybrids are fertile, the conclusion reached is that the plants used by Hoshi & Kondo were in fact *D. aliciae* and not *D. sessilifolia*.

Among the Brazilian *Drosera* taxa here analyzed no significant differences in chromosome lengths were observed for any one species, although the chromosomes of the tetraploid taxa were always relatively smaller than those of the diploid taxa. The only exception was *D. sessilifolia* which, like the tetraploid taxa, was found to posses relatively small chromosomes. Futagawa *et al.* (2002) describe chromosomes varying between 1.02-2.95µm in length for the diploid species *D. filiformis*, *D. capillaris*, and *D. brevifolia* while the tetraploids *D. graminifolia*, *D. montana*, and *D. villosa* plus the diploid *D. sessilifolia* have chromosomes varying between 0.43-1.56µm in length.

The relatively smaller size of the chromosomes observed among the Brazilian tetraploid species suggests that there has been chromosome reduction subsequent to the polyploidization event. This is a frequent occurrence in polyploid taxa, where the doubling (or more) of the whole genome permits the subsequent loss over time of repeated sections (coding and non-coding regions) without compromising functionality of the chromosomes (Degreef, 1990; Rothfels & Heimburger, 1968).

Taxa Examined	2n	Herbarium Vouchers (deposited at SPF)
D. ascendens A.Saint-Hilaire	40	São Paulo. São Bernardo do Campo: ao lado da rodovia dos Imigrantes, 12/Nov./1992, *Rivadavia 153.*
D. brevifolia Pursh	20	Paraná. São Luís do Purunã: estrada Curitiba - Ponta Grossa (BR 376), 21/Apr./1995, *Rivadavia et al. 393.*
D. camporupestris F.Rivadavia	40	Minas Gerais. Jaboticatubas: Serra do Cipó, Fazenda da Serra do Cipó, 6/Jul./1995, *Rivadavia 447.*
D. chrysolepis Taubert	40	Minas Gerais. Santana do Riacho: Serra do Cipó, bifurcação da estr. Conceição do Mato Dentro-Morro do Pilar, 5/Jun./1994, *Rivadavia 288.*
D. cayennensis Sagot ex Diels	20	Mato Grosso. Chapada dos Guimarães: nascente ao lado do córr. da Mata Fria, 23/Feb./1994, *Rivadavia & Cardoso 255.*
D. cayennensis Sagot ex Diels	20	Mato Grosso. Chapada dos Guimarães: descendo a encosta do Mirante, 30/Apr./1995, *Rivadavia & Cardoso 425.*
D. communis A.Saint-Hilaire	20	Mato Grosso. Chapada dos Guimarães: nascente brejosa do córr. Mata Fria, 23/Feb./1994, *Rivadavia & Cardoso 257.*
D. communis A.Saint-Hilaire	20	Minas Gerais. Grão Mogol: Morro do Jambeiro, 3/Jun./1994, *Rivadavia 284.*
D. communis A.Saint-Hilaire	20	São Paulo. Cotia: após Vargem Grande, estrada p/ Ibiúna, 13/Feb./1996, *Rivadavia et al. 512.*
D. grantsaui F.Rivadavia	40	Minas Gerais. Grão Mogol: Morro do Jambeiro, 8/Sep./1994, *Rivadavia 299.*
D. grantsaui F.Rivadavia	40	Minas Gerais. Botumirim: Serra da Canastra, 21/Dec./1994, *Rivadavia 339.*
D. grantsaui F.Rivadavia × *D. tomentosa* A.Saint-Hilaire	40	Minas Gerais. Grão Mogol: Morro do Jambeiro, 3/Jun./1994, *Rivadavia 286.*
D. graminifolia A.Saint-Hilaire	40	Minas Gerais. Grão Mogol: Trilha da Tropa, 7/Sep./1994, *Rivadavia 295.*
D. graminifolia A.Saint-Hilaire	40	Minas Gerais. Diamantina: metade do caminho para Biri-Biri, 7/Jul./1995, *Rivadavia et al. 453.*
D. graomogolensis T.Silva	40	Minas Gerais. Grão Mogol: Morro do Jambeiro, 8/Sep./1994, *Rivadavia 297.*
D. hirtella A.Saint-Hilaire var. *hirtella*	20	Minas Gerais. Jaboticatubas: trilha p/ o mirante do canyon, 6/Jul./1995, *Rivadavia 445.*
D. hirtella A.Saint-Hilaire var. *lutescens* A.Saint-Hilaire	20	Mato Grosso. Chapada dos Guimarães: arredores da cachoeira Véu de Noiva, 30/Apr./1995, *Rivadavia & Cardoso 424.*
D. tomentosa A.Saint-Hilaire	40	Minas Gerais. Jaboticatubas: Serra do Cipó, morro entre sede do IBAMA e estátua do Juquinha, 4/Jul./1995, *Rivadavia 439.*
D. tomentosa A.Saint-Hilaire	40	Minas Gerais. Jaboticatubas: Serra do Cipó, Fazenda da Serra do Cipó, 6/Jul./1995, *Rivadavia 449.*
D. tomentosa A.Saint-Hilaire	40	Minas Gerais. Grão Mogol: Morro do Jambeiro, nascente brejosa, 8/Sep./1994, *Rivadavia 298.*
D. sessilifolia A.Saint-Hilaire	20	Mato Grosso. Chapada dos Guimarães: Salgadeira, 15/Feb./1992, *Cardoso s/n.*
D. tentaculata F.Rivadavia	40	Minas Gerais. Jaboticatubas: trilha p/o mirante do canyon da Bocaina, 23/Feb./1996, *Rivadavia & Mullins 541.*
D. villosa A.Saint-Hilaire	40	Minas Gerais. Lima Duarte: Parque Estadual Florestal de Ibitipoca, Morro da Lombada, 30/Oct./1995, *Rivadavia & Padovese 507.*
D. viridis F.Rivadavia	20	São Paulo. Paranapiacaba: *c.*2km antes da cidade, 21/Apr./1995, *Rivadavia & Cardoso 393.*

Table 2: List of the *Drosera* L. (Droseraceae) taxa collected in Brazil, their chromosome numbers, and voucher specimens. All plants were collected and cultivated by the author at the Botany Department of the University of São Paulo and the herbarium vouchers are deposited at SPF.

Taxa Examined	2n	Place of Origin
D. aliciae Hamet	40	South Africa, Cape Province
D. capensis L.	40	South Africa, Cape Province
D. cistiflora L. — purple flowers	60	South Africa, Cape Province
D. filiformis Raf. var. *tracyi* (Macf.) Diels	20	Southeastern USA
D. intermedia Hayne	20	Mt.Roraima, Venezuela
D. roraimae (Klotzsch ex Diels) Maguire & Laudon	20	Mt.Roraima, Venezuela
D. spatulata Labill. — pink flowers	30	Beerwah, Queensland, Australia

Table 3: List of the *Drosera* L. (Droseraceae) taxa obtained as seeds or from vegetative propagation, their chromosome numbers, and their place of origin. All plants were cultivated by the author at the Botany Department of the University of São Paulo.

The difference in chromosome length observed between the diploid and tetraploid taxa suggests that the polyploidization event may be ancient and therefore any obvious signs of hybrid origin, such as bimodal karyotypes, may already have been erased. Bimodal karyotypes (when two sets of chromosomes are clearly visible due to differences in size) have been used as evidence of recent hybridogenic origin through amphiploidy (hybridization followed by duplication of the whole genome, allowing sterile crosses to become fertile) for *D. anglica* and *D. tokaiensis* (Komiya & Shibata) T.Nakamura & Ueda, with the probable crosses being *D. rotundifolia* with *D. linearis* Goldie for the former (Kondo & Segawa, 1988; Wood, 1955) and *D. rotundifolia* with a tetraploid *D. spatulata* Labill. for the latter (T.Nakamura & Ueda, 1991).

Drosera adelae is included by Schlauer (1996) in sect. *Prolifera* together with *D. prolifera* C.T.White and *D. schizandra* Diels, all of which are native to Northeastern Australia (Diels, 1906; Schlauer, 1987) and have been reported to have 2n=30 (Kondo, 1976; Kondo & Lavarack, 1984; Kondo & Olivier, 1979). Yet 2n=28 has also been reported for a cultivated cytotype of *D. adelae* (Kondo, 1976). The two chromosome numbers recorded for *D. adelae* may represent different forms of this taxon known to cultivation, such as the red and the salmon-pink flower forms.

Drosera indica is the sole member of sect. *Arachnopus* (Schlauer, 1996) and is native to the tropics and subtropics of Africa, Asia, and Australia (Diels, 1906; Schlauer, 1987). The chromosome number of 2n=28 has been recorded more than once for this species (Kondo & Lavarack, 1984; Peng *et al.*, 1986; Venkatasubban, 1950), although if one considers how morphologically variable and geographically widespread *D. indica* is, it is not unlikely that populations with different chromosome numbers exist, possibly even 2n=30.

Centromeres were not observed in any of the taxa in this study and are probably diffused along the entire length of the chromosomes, as has been suggested by Sheikh *et al.* (1995).

Conclusions

Previously published chromosome numbers are here confirmed for some taxa and several new counts are reported, including a few tetraploid South American taxa and the first triploid *Drosera spatulata*.

Chromosome numbers for Droseraceae are remarkably consistent with phylogeny inferred from recent molecular data (Rivadavia *et al.*, 2003). The phylogenetic tree inferred from the DNA sequences of chloroplast rbcL gene show the pygmy sundews of subgen. *Bryastrum* as a sister group to subgen. *Lasiocephala*, and curiously both have relatively low chromosome numbers, varying from 2n=6 to 28 in the former and 2n=12-24 in the latter. The tuberous sundews of subgen. *Ergaleium* are shown to form a sister clade to subgen. *Phycopsis*, and the chromosome numbers known for both are relatively high, varying from 14-40 in the former and 32-64 in the latter. Basal to these four subgenera is *D. glanduligera* Lehm. Which surprisingly has an intermediate chromosome number of 2n=22.

On another branch of this phylogenetic tree one finds African sundews towards the apex, including species from subgen. *Drosera* sect. *Drosera*, sect. *Oosperma* and sect. *Ptycnostygma*, suggesting these sections are not monophyletic. Chromosome numbers in this branch include 2n=20, 40, 60, and 80, as well as the doubtful 2n=32. Sister to this group are the tetraploid Brazilian taxa of sub-

gen. *Drosera* sect. *Drosera* and sect. *Oosperma* reported above. Just below these two branches is another branch that includes a majority of diploid taxa from subgen. *Drosera* sect. *Drosera* and sect. *Oosperma* native to the New World and the Northern Hemisphere.

An apparently unrelated group of species that branch together on the phylogenetic tree is also supported by chromosome numbers. *Drosera adelae*, *D. indica*, and *D. hamiltonii* are all reported to have 2n=28, a rather rare number in the genus. Furthermore *D. burmannii* and *D. sessilifolia* branch together, both having 2n=20. The two basal species in the genus *Drosera* are *D. arcturi* Hook and *D. regia* Stephens. The latter has 2n=34, a relatively high number, as with the closely related genera *Dionaea* (2n=30, 32 and 33) and *Aldrovanda* (2n=38 and 48) while the latter has 2n=20, a number that could be considered as basic for the genus.

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GROWING *UTRICULARIA GIBBA*

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Keywords: cultivation: *Utricularia gibba.*

I like aquatic plants and have three aquaria filled with them and fish. So when I saw *Utricularia gibba* listed on the ICPS seed bank inventory, I was immediately tempted. Since I am a librarian I am an information geek, and totally research any new plant I try. Since I could find no specific instructions about growing aquatic *Utricularia* from seed, I accumulated what I could find about *U. gibba* and its environment. Taylor (1989) described it as an aquatic that is mostly anchored, sometimes free floating. All the writings I found, Taylor included, stated that *U. gibba* flowers only in very shallow water, or at least when a web of it is supported in deeper water by a floating mat of other vegetation or its own accumulation of biomass.

I thus decided to try to grow the seeds in a small container with a substrate, since I thought that in nature the seed capsules would open and disperse the seed where the flowers bloomed—in shallow water, with the *U. gibba* anchored in the substrate below. I washed a few milliliters of fine silica sand several times (to remove any salts) and mixed it with an equal part of Canadian peat moss, and transferred the mix to an old fashioned, wide-mouth glass mason jar containing about 350 ml (1 1/2 cups) of distilled water. I let the mixture mature in a bright north window for about a week and a half. The sand and peat settled to the bottom of the jar, leaving the water with a very slight peaty look. I did not put it under my lights because I did not want to encourage any algae growth that would compete with the seeds.

After a week and a half, I sprinkled the seeds on top of the water. Usually when I plant seeds, I try them in a variety of containers and media, but these seeds were so small that I decided to put them all in the single mason jar. I debated about stirring or disturbing the water in any way, but decided that in nature the seeds would land on top of the water and do what they do, so I simply returned the undisturbed jar to the bright north window. I planted the seed on 4 July 2003 (I keep detailed records of all my attempts). I did nothing to the jar, but examined it frequently. On 28 July 2003 I saw a tiny green thread, just 1-2 mm long. What was interesting was that the thread was suspended in the middle of the jar, half way from the surface and the bottom. I could see no evidence of green on the peat slurry at the bottom of the jar. I put the jar close up under my plant lights. By 9 August 2003, the first thread was 5 cm (2 inches) long; at that point the *Utricularia* took off, quickly growing into a mass of green threads. I do not know how many of those original seeds sprouted because I had no chance of noticing any other

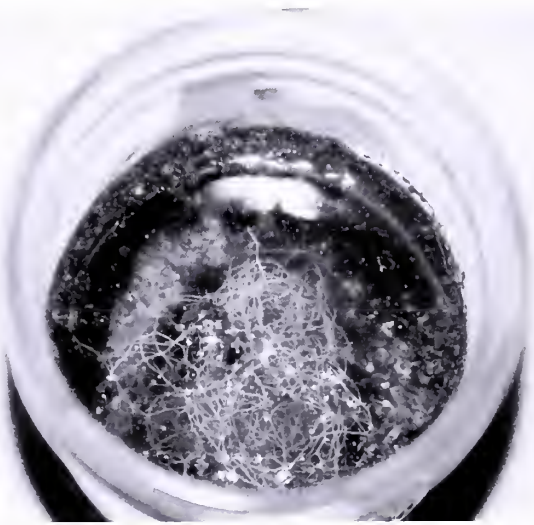

Figure 1: My jar of *Utricularia gibba*. Photograph by Steven Holloway.

Figure 2: Part of my growing set-up for carnivorous plants. Photograph by Steven Holloway.

individual sprouts in the web mass.

My *Utricularia gibba* has filled the mason jar and is still doing nicely (see Figure 1). I do not seem to have as much trouble with algae as others have reported on the internet. I have twice scooped out my *Utricularia gibba*, rinsed it in several changes of distilled water, picked out clumps of algae with tweezers, scrubbed out the mason jar with hot water and prepared new substrate, but basically I pick out clumps of algae with my tweezers from time to time. To date, my *Utricularia gibba* has not flowered, and shows no interest in anchoring itself to the bottom even though it is growing in only a few centimeters of water. It is totally a midlevel plant and only the occasional stray stolon reaches down towards the substrate. I have noticed that all the bladders seem to be near the surface of the water. If I look down onto the surface of the mason jar, I see hundreds of bladders, but if I peer at them sideways through the jar, I see mostly a net of stolons.

From what I have read, the other aquatics (which are usually much bigger) like deeper water, thin sheets of water over deep muck, or are rare specialists anchored in running water, so I do not know how my success with *U. gibba* could apply to them. I would like to grow other aquatic *Utricularia*, as bladderworts are my favorite carnivorous plants and I would like to add more to my a modest collection of carnivorous plants (see Figure 2). However, I believe the other aquatics would be far beyond my Chicago apartment. I feel no need to accumulate an immense growlist, but rather I enjoy reading about all the other rare and interesting *Utricularia* species in their natural habitats, and I collect the information in large binders. So you see, I am a librarian at heart.

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Looking Back: CPN 25 years ago

Notes were reprinted from a 1932 *Sarracenia* collecting trip by the highly regarded Dr. E.T. Wherry, through the southeastern USA. While this kind of collecting trip would be hard to justify today, it is a remarkable read. For example, from his search for *S. jonesii*: "Its colonies proved to have been nearly destroyed by drainage of the swamps and by the raids of vandals from the towns, but enough remained to enable this species to be added to the collection. With it grew some beautifully veined *Sarracenia venosa*.... We also found hybrids between *S. venosa* and *S. jonesii*." Note: we now would refer to the "beautifully veined" species as *Sarracenia purpurea* subsp. *venosa* var. *montana*.

Student Experiment Project: Number of closures of *Dionaea muscipula* leaves

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Keywords: cultivation, observations: *Dionaea muscipula.*

Introduction

When stimulated, a trigger hair on the leaf of *Dionaea muscipula* sends an electric signal that results in leaf closure. The details of the mechanism are not well understood. In order to learn more about this process, I studied 43 traps of fifteen *Dionaea muscipula* plants over ten weeks. My goal was to learn how many times a trap could be induced to close. I have been told that the flytraps close about 7-12 times before becoming immobile (Sandoval, pers. comm.). Similarly Schnell (2002) says that each trap can handle 8-10 "nonfeeding closures" and three to four digestion processes. I wanted to test this. Accurate information on the persistence of traps under repeated stimulation would be useful for us at the University of California, because our plants are frequently poked by the public.

Method

For this experiment, I used fifteen healthy plants (including regular clones as well as specimens of *Dionaea* 'Dentate Traps' and *Dionaea* 'Jaws'). The plants were placed in a netted environment. The plants were given sufficient time to produce new traps, and only these new and previously untriggered traps were used in the experiment. The plants were grown in an environment that was previously shown to be ideal for *Dionaea* growth (in trays in full sun—although the netting gave some shading).

The traps were stimulated to close by lightly touching the trigger hairs inside the trap two or more times with a toothpick. Only traps sufficiently widely open (i.e. with the marginal teeth not overlapping) were stimulated—for the cases where the traps were not completely open, they were passed over to give them additional time to reset. The length of each trap lobe (excluding marginal teeth) was measured with a ruler from its sides at the widest part.

Results

I found that traps could be stimulated to close on average 12.1±4.0 times. I found no significant relationship of trap closure number with trap size. Older traps often required more than two stimulations in order to react, and even then they did not always close completely (or subsequently reopen). It appears that either traps can be triggered to close a little more frequently than usually stated, or we are simply growing our plants very well!

Upon reflection, I wonder if the fact that I waited only 24 hours after the traps opened, before I re-stimulated them, may have inflated the number of times that I measured the traps can be triggered to close. Darwin (1896) noted that *Dionaea* finishes two thirds of its post-triggering "re-expansion" in 24 hours, but requires 32 hours to completely reset. Perhaps my experiment should allow more than 24 hours between triggering. As a result of triggering too early, the experiment may have generated high data values. Waiting longer between triggerings will be an interesting experiment to try next.

Testing the endurance for flytraps to go through the entire digestion process (which takes about a week) is another possible experiment.

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